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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/692,722	10/27/2003	Hiroshi Morioka	032045	9699

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EXAMINER	
CHACKO DAVIS, DABORAH	
ART UNIT	PAPER NUMBER
1795	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/692,722	MORIOKA, HIROSHI	
	Examiner	Art Unit	
	DABORAH CHACKO DAVIS	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 August 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4,6-12,14-17,19 and 21-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4,6-12,14-17,19 and 21-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-2, 4-6, 9-12, 14, 17, 19, 21-22, and 31-33, are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 6,579,808 (Cho et al., hereinafter referred to as Cho) in view of U. S. Patent No. 6,110,826 (Lou et al., hereinafter referred to as Lou).

Cho, in the abstract, in col 2, lines 53-67, in col 3, lines 18-67, in col 4, lines 1-60, discloses a patterning forming method of forming a gate layer on the substrate, followed by an insulating layer, forming an organic antireflection layer (antireflection layer made of an organic substance) on the insulating layer, forming a photoresist layer on the antireflecting layer, performing an exposure and development process on the photoresist layer to form a photoresist pattern (substrate at about room temperature), dry etching the sidewalls and top portions of the photoresist pattern using SO_2 and He as the etch gas mixture i.e., the photoresist pattern formed after the development and prior to post development process has a window of smaller width i.e., it causes the width of the exposed portion of the antireflective film to be smaller, and the photoresist pattern after dry etching processes i.e., causing surface sidewalls to be etched and resulting in a window that is larger than that after development i.e., it causes the width

of the exposed portion of the antireflection film to be larger than prior to the post-development processes performed; wherein the second gas i.e., SO_2 gas forms or generates polymer; etching the antireflecting layer using the resist pattern as the mask, etching the insulating film (first film) using the patterned antireflecting layer as the mask, removing the resist pattern and the patterned anti-reflecting layer, forming the gate structure (not shown) underlying the insulating film pattern. Also, as illustrated in figures 3A, 3B, 3C, and 3D, the underlying surface exposed after the etching of the antireflection film, the surface area exposed of the underlying insulating layer is larger than the surface area of the antireflection film exposed after the development of the photoresist (see figure 3D) (claims 1, 4-5, 9-11, 14, 17, 19, 31-33). Cho, in col 3, lines 28-31, discloses that the semiconductor substrate further includes implanting ions to form source and drain regions, and a gate (claim 21). Cho, in col 4, lines 14-17, and lines 44-52, discloses that the over etch performed on the antireflecting coating and photoresist film results in a reduced dimension of the same (claim 22).

The difference between the claims and Cho is that Cho does not disclose that the flow rate of the first gas is equal to or greater than 40% of a flow rate of the mixture gas. Cho does not disclose that the mixture of etch gases includes oxygen (claims 2, 6, 12).

Lou, in col 6, lines 1-15, discloses that the mixture of gases includes oxygen, and that the flow rate of the first gas i.e., helium (He) is at least greater than 40% of flow rate of the mixture of gases.

Therefore, it would be obvious to a skilled artisan to modify Cho by including oxygen in the mixture of etch gases, and by utilizing the gas flow rates suggested by

Lou because Lou, in col 6, lines 1-15, discloses that after the image formation of the line trench in the photoresist layer, a plasma etch is performed on the exposed photoresist using etch gases such as O_2, SO_2, and He in the claimed flow rate, so as to continue the etch process until the etch stop layer is reached while forming a line trench pattern in the underlayer. Although, Cho does not disclose implanting ions to form the source and drain regions after step (o) of claim 10, It would be obvious to a skilled artisan to implant after the removal of the resist pattern (PR pattern) and patterned antireflection film (AR pattern) because Cho, in col 3, lines 31-32, discloses that the semiconductor substrate has a transistor, i.e., source and drain regions are to be formed, and in figure 3D illustrates the removal of the AR pattern and PR pattern corresponding to the conductive region i.e., the source/drain region can be implanted to form conductive regions (see reference 202).

3. Claims 7-8, and 15-16, are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 6,579,808 (Cho et al., hereinafter referred to as Cho) in view of U. S. Patent No. 6,110,826 (Lou et al., hereinafter referred to as Lou) as applied to claims 1-2, 4-6, 9-12, 14, 17, 19, 21-22, above and further in view of U. S. Patent No. 6,187,688 (Ohkuni et al., hereinafter referred to as Ohkuni).

Cho in view of Lou is discussed in paragraph no. 4.

The difference between the claims and Cho in view of Lou is that Cho in view of Lou does not disclose increasing the flow rate of the SO_2 gas to a flow rate of the oxygen gas during etching (claims 7, and 15). Cho in view of Lou does not disclose that

the flow rate of SO_2 gas is increased when the time necessary for etching a whole thickness of the antireflection film elapses (claims 8, and 16).

Ohkuni, in col 10, lines 50-53, in col 11, lines 1-29, discloses that the flow rate of the SO_2 gas is maintained higher than the flow rate of the oxygen during the dry etch process of the antireflecting film.

Therefore, it would be obvious to a skilled artisan to modify Cho in view of Lou by employing the flow rate of the SO_2 gas as suggested by Ohkuni because Ohkuni, in col 13, lines 63-67, discloses that increasing the flow rate of the SO_2 gas results in a positive size variation in the sidewalls of the antireflection pattern.

4. Claims 23-26, are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 6,579,808 (Cho et al., hereinafter referred to as Cho) in view of U. S. Patent No. 6,110,826 (Lou et al., hereinafter referred to as Lou) as applied to claims 1-2, 4-6, 9-12, 14, 17, 19, 21-22, above and further in view of U. S. Patent Application Publication No. 2003/0134231 (Tsai et al., hereinafter referred to as Tsai).

Cho in view of Lou is discussed in paragraph no. 4.

The difference between the claims and Cho in view of Lou is that Cho in view of Lou does not disclose that the etching of the resist pattern reduces the width of the resist pattern (claims 23-26).

Tsai, in [0007], discloses that SO_2/O_2 mixture gas is used to reduce the resist pattern width (reduction in critical dimension, i.e., reduction in pattern width).

Therefore, it would be obvious to a skilled artisan to modify Cho in view of Lou by

performing the etch process suggested by Tsai to reduce the pattern width because Tsai, in [0007], discloses that performing the etch process on the resist pattern increase the etching process anisotropy and reduces microloading effects.

5. Claims 27-30, are rejected under 35 U.S.C. 102(e) as being unpatentable over U. S. Patent No. 6,579,808 (Cho et al., hereinafter referred to as Cho) in view of U. S. Patent Application Publication No. 2002/0061654 (Kanegae et al., hereinafter referred to as Kanegae).

Cho, in the abstract, in col 3, lines 18-67, in col 4, lines 1-60, discloses a patterning forming method of forming a gate layer on the substrate, followed by an insulating layer, forming an organic antireflection layer on the insulating layer, forming a photoresist layer on the antireflecting layer, performing an exposure and development process on the photoresist layer to form a photoresist pattern (substrate at about room temperature), dry etching the sidewalls and top portions of the photoresist pattern using SO_2 , and He as the etch gas mixture; etching the antireflecting layer using the resist pattern as the mask, etching the insulating film (first film) using the patterned antireflecting layer as the mask, removing the resist pattern and the patterned antireflecting layer, forming the gate structure underlying the insulating film pattern (claims 27, and 28).

The difference between the claims and Cho is that Cho does not disclose that the first gas is selected from the group consisting of Ne, Ar, Xe, Kr, CO, CO_2, and N_2. Cho does not disclose that the first gas is selected from the group consisting of CO, CO_2, and N_2 (claims 29-30).

Kanegae, in [0168], discloses that a rare gas such as Ar, Kr, Xe, Ne etc., is mixed with the main etching gas used for plasma etching. Kanegae, in [0168], discloses that the CO or CO_2 can be added to the main etching gas.

Therefore, it would be obvious to a skilled artisan to modify Cho by employing one of the rare gases suggested by Kanegae because Cho includes a rare gas such as He in the etch gas mixture, and Kanegae, in [0168], discloses that using any one of the rare gases (noble gases such as He, Ne, Ar, Kr, Xe, etc.,) dilutes the etching gas, increases the discharge rate of the gas in the reaction chamber, and controls the electron temperature of the plasma. It would be obvious to a skilled artisan to modify Cho by including CO or CO_2 in the etching gas mixture as suggested by Kanegae because Kanegae, in [0168], teaches that adding CO or CO_2 in the etching gas mixture improves the etching ability of the resist pattern as an etching mask.

Response to Arguments

6. Applicant's arguments, see Remarks, filed July 14, 2008, have been fully considered but they are not persuasive. The 103 rejections made in the previous office action (paper no. 20080202) are maintained.

A) Applicants argue that Cho does not disclose that the underlying surface exposed after etching the antireflection film is larger than the surface of the antireflection film exposed after developing the photosensitive resist film.

Cho, in figures 3A-3B, discloses the width of the antireflection film surface exposed after the development of the photoresist film, i.e., the antireflection film surface width exposed is reduced to b2, and in figure 3D, discloses the width of the underlying

insulating film that is exposed after the etching of the antireflection film i.e., surface of the insulating film exposed is larger than the width b2 of the antireflection film exposed after the photoresist film development.

B) Applicants argue that there is no reason for using the etch gas and gas flow rate of Lou for the device of Cho,

Cho teaches the use of an oxygen containing gas such as SO_2 along with an inert gas as an etch gas mixture. Lou teaches in col 6, lines 1-15, that the photoresist pattern on the IMD layer is exposed to an etch plasma preferably comprising SO_2, O_2, and He, i.e., the PR pattern is subjected to etch on the sidewalls and surfaces during the exposure to the etch gas, and that using the claimed etch gas mixture in the claimed sccm range (flow rate) results in the removal of the underlying etch-stop layer from the bottom trench along with the transfer of the pattern of the resist layer to the IMD layer i.e., the instead of only transferring the pattern to the IMD layer during an etch process, using the claimed etch gas mixture results in both elimination of the etch-stop layer in the bottom portion of the trench to be formed and (at the same time) transfer of the pattern from the resist layer to the IMD layer. The reason to use the gas suggested by Lou and to employ the flow rate of the inert gas suggested by Lou is clearly written in the motivational statement of paragraph no. 2.

C) Applicants argue that both Cho and Lou teach etching of different materials using the SO_2 and He as the etch gas.

The claims recite exposing the resist pattern to a plasma of a mixture of gases i.e., SO_2, He, etc. Both Cho and Lou teach exposing the formed resist pattern to a

further etching gas mixture comprising the same gas mixture (SO_2, He etc.) i.e., the etch gas mixture will perform both sidewall and surface topography variations on the resist pattern due to such a plasma etch process.

D) Applicants argue that Cho teaches away from the inclusion of oxygen in the etch gas as cited in col 3, lines 62-63.

Cho does not teach away from the use of oxygen in the gas mixture. The argued citation merely discloses the reactivity rate comparison of SO_2 to that of O_2 gas. Also the first dry etch process taught by Cho only discloses the use of SO_2 and He. Therefore, Cho does not disclose that oxygen cannot be added to the etch gas mixture of SO_2 and He.

E) Applicants argue that Tsai does not teach a reduction in pattern width.

Tsai, in [0007], admits that the photoresist pattern exposed to dry development in sulfur dioxide chemistry i.e., dry etching, results in a critical dimension loss i.e., it will cause a reduction in the width of the resist pattern.

F) Applicants argue that neither Cho nor Kanegae disclose that the claimed rare gas is mixed with the main etching gas that is not halogen based gas, and that the rare gases of Kanegae cannot replace the rare gas of Cho.

Kanegae is not depended upon to disclose a main etching gas. The claims do not recite a main etching gas. Cho already teaches using a rare gas viz., helium, and a SO_2 gas mixture as the etch gas mixture. Kanegae is depended upon to disclose the use of other rare gases along with the etching gas of Cho. Also, Kanegae, in [0168],

teaches that adding CO or CO_2 in the etching gas mixture improves the etching ability of the resist pattern as an etching mask.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daborah Chacko-Davis whose telephone number is (571) 272-1380. The examiner can normally be reached on M-F 9:30 - 6:00. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark F Huff can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

dcd

/Daborah Chacko-Davis/
Examiner, Art Unit 1795

September 13, 2008.